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III. *Another Letter from the same Mr Leewuenhoek, concerning his observations on Rain Water.*

Delft, April, 28. 1701.

ON the 19th of *Septemb.* 1701. it rain'd a little while about noon, whereupon I intercepted some of the Water in a fine *China* Basin, made as clean as was possible.

I put this Water into a Glass Tube, in order to try whether there were any living Creatures in it.

I view'd this Water several days together, and could discover in it abundance of small Atoms of Dust or Particles that were floating in the Air, and consisting of exceeding small parts of burnt Wood or Charcoal wherein I did perceive the Horizontal and Ascending Vessels, also a very small piece of Straw, and several blackish Particles which I imagin'd to be conglomerated Atoms of the smoke proceeding from the Coals which our Brewers and Smiths use, and among these was an odd Phenomenon made up of little round Bubbles, that were, as I may say, congeal'd together, like our little Stars of Snow in Winter; but I could meet with no living Creatures till the 28th of *September*, at which time I discovered exceeding small *Animalcula*, that one while fasten'd themselves to the sides of the Glass, and then swam in the Water with a tremulous motion, which was a very agreeable spectacle.

These Creatures were so very small, and the Glass Tube so thick, that it was very difficult for me to see them, and the more because they were as Pellucid as the Glass itself; their Bodies were twice as long as they were big, and both ends thereof Taper, or dwindling into a small Point.

From the 10th of *October* to the 14th I could find no living Creatures in the Water, tho I sought them very carefully.

Where-

Whereas I was used only to observe the upper part of the Water in the Glass Tube, now on the 15th of *October* I turned my speculations towards the bottom of the said Tube, which was 4 inches long, and $\frac{1}{2}$ Diameter; and there I could perceive abundance of those *Animalcula*, some sitting on the sides of the Glass, and others Swimming, and as they were in Shoals together, when one of the Company stirred, all the rest that were near moved also.

Not content with these observations (because it was possible that there had been Water in the Tube before, and that from thence these *Animalcula* might have proceeded) I took another Tube that had lain dry near 20 years in a Chest, and where I was well assured, that neither Water nor any other matter had been put, excepting Air and such Atoms as are always floating in it.

On the 18th of *October* it rained in the morning, after that we had had very stormy Weather for several days.

I received some of the said Rain in a *China* Basin, and twice I threw away what I had received, but the third time I put it into a Glass Tube.

I viewed this last Water several days, but notwithstanding all the Pains I took, I could not discover any thing that had life in it, true it is, I saw little Particles fixt to the sides of the Glass, that came very near in figure and size to the afore-mentioned *Animalcula*, but on the 24th ditto, I did discover plainly three of those Creatures running on the Glass, and Swimming in the Water, not in a strait line, but in circles and windings in their progression, and the next day I could perceive in ten different places some of the *Animalcula* running, and others swimming, and that as distinctly, as when we see with our naked Eyes those little Creatures which the Common People call Water Fleas, swimming in the ordinary Brooks and Canals.

Now I could observe against the sides of the Glass, in the compass of a large Sand, above an hundred Particles that were of the size of the aforesaid *Animalcula*, which Parti-

es I viewed several times, in order to see, if it were possible, whether they were living Creatures, or whether there were any thereabouts ; but with all my circumspection I could discover nothing till the 28th. of the said Month, of *October*, at which time I did perceive five and twenty *Animalcula* proceeding from the last mentioned Particles, and swimming or running about the sides of the Glass ; and then I did also observe two sorts of these *Animalcula*, and the smallest sort appeared to me, sometimes shining and sometimes not, which appearance I did imagin might proceed from the light reflected from the smooth back of those Creatures, and this last sort had quite a different motion in Swimming, from those other which were a little bigger ; in the remaining Particles that stuck to the sides of the Tube I could perceive no alteration.

I farther observed the said Water several days following, and was amazed to see the smallest sort of these *Animalcula* in such mighty numbers where-ever I cast my Eye, either swimming or running about the sides of the Tube ; and whereas I held the Glass Tube full of Water in my hand, and consequently put the Water in a gentle kind of motion, I could perceive that the Stream (if I may so call it) would often be too strong for these *Animalcula*, and carry them along with it ; and the chiefest difference I could find between these *Animalcula* and the inanimate Particles, which I told you I observed in the Water also, and which were very like the other, was, that the former made small angles in their swimming, whereas the latter always moved in a right Line.

I have also observed, that when I put Water into a Glass Tube that had never been wet, abundance of Air-bubbles appeared, which staid on the Glass a little while and then vanished.

That I might be better satisfied in this matter, on the 6th of *November* I took a new Glass Tube, and tho I had most carefully shut it up and cover'd it close, I could see abundance of small Particles in it. On

On the same day it rain'd again, and I intercepted the Water as before, and put it into the Glass Tube, to see whither there were any Air-bubbles, and whether they would disappear like the other.

I observed the Water several times, even after it had been four hours in the Tube, and in that time discover'd but 2 or 3 Air-bubbles, and that was in a dry Particle from whence the Air seem'd to proceed.

I had placed the fore-mentioned Tube perpendicularly, and another obliquely, but the last I laid down almost horizontally, only the Orifice of it was rais'd a little higher, that the Water might not run out of it, and that the Air-bubbles might keep their place in the uppermost parts of the Glass. After the space of ten hours I saw a great number of Air-bubbles that were for the most part fastned to the said Atoms; and whereas we well know that no dry or other Particles that have Air included in them can admit of Water till the Air be dislodged, this rule holds also in the Particles that are found in our Glass Tube; but what shall one say? Some of the Air-bubbles were a hundred, others several hundred times bigger than the Atoms to which they were fixt. The next day in the morning I could perceive but 4 very small Air-bubbles, and a few hours after they were all gone.

I view'd this Water till the 14th of *Novemb.* but could not see any living Creatures in it, and the next day I had the ill luck to break my Tube.

A certain Fisherman brought me some Eels that were no bigger than a large Pin, some of which, that were of a darkish colour, I observed before several persons of Quality, who with great pleasure could very distinctly see the the Blood circulate, notwithstanding the exceeding smallness of the Vessels; but the next day viewing by my self one of those little Creatures, that was changed almost white, I could hardly see the Circulation of the Blood, which even in the biggest vessels (by reason of the few Globules in it) had scarce any Tincture of Red.